United States Patent [19]

Bonzo

[11] **4,184,653**

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[54] **SPOOL FOR FILAMENT WINDER**

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[51] **Int. Cl.**^{2} **B65H 75/28**

[52] **U.S. Cl.** .... **242/125.1;** 242/18 PW

[58] **Field of Search** .... 242/125.1, 125, 125.2, 242/18 PW, 18 EW, 18 A

[56] **References Cited**

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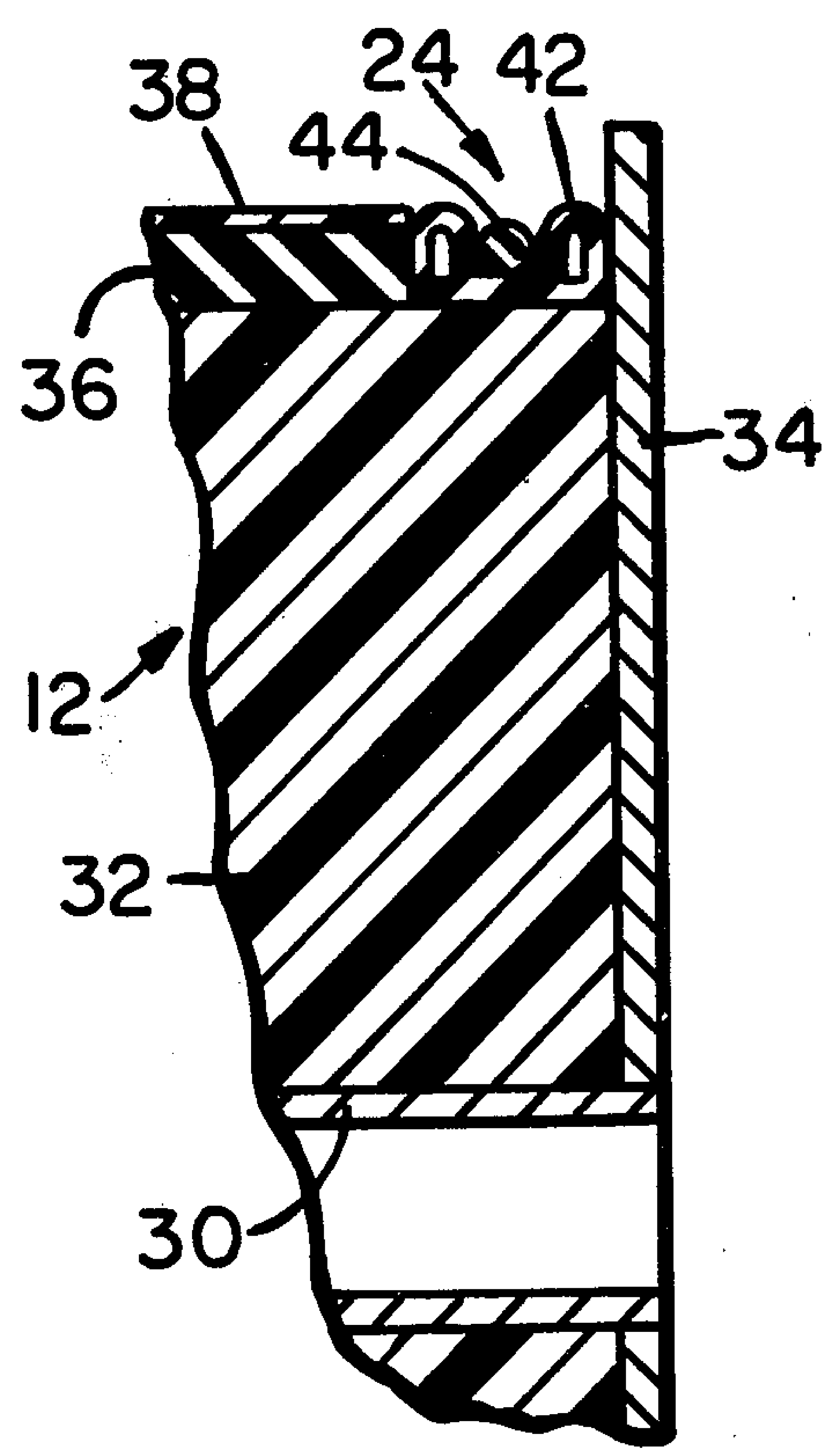
[57] **ABSTRACT**

A spool is disclosed for winding an optical waveguide filament during the drawing thereof. Each end of the spool is provided with an annular resilient member which forms a part of a channel for receiving the filament. The resilient member must be displaced while the filament is in contact therewith to provide a gap through which the filament can pass. After the gap closes, the filament is gripped by the resilient member. In this manner both ends of a wound filament can be secured to the ends of a spool.

3 Claims, 9 Drawing Figures



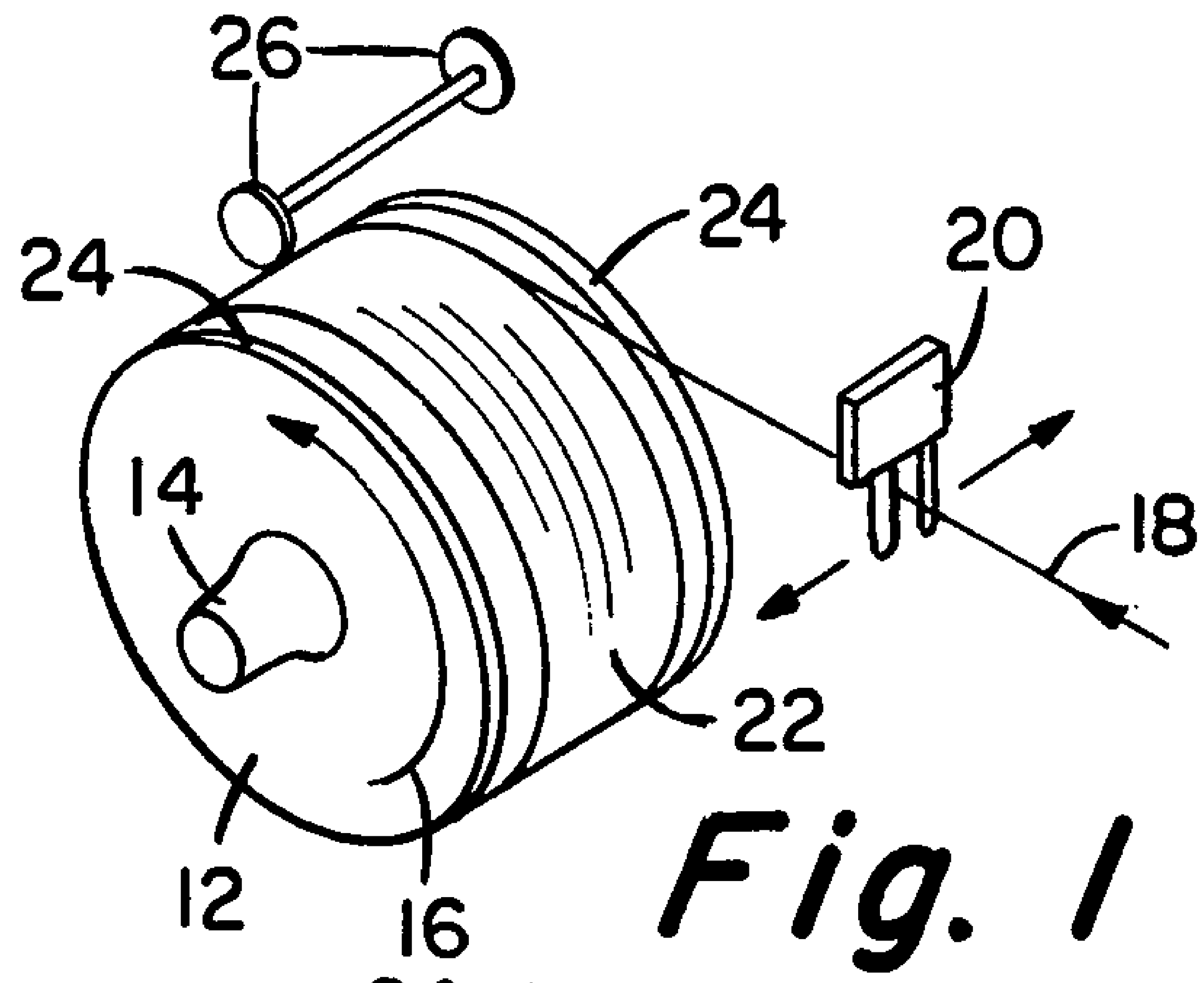


Fig. 1

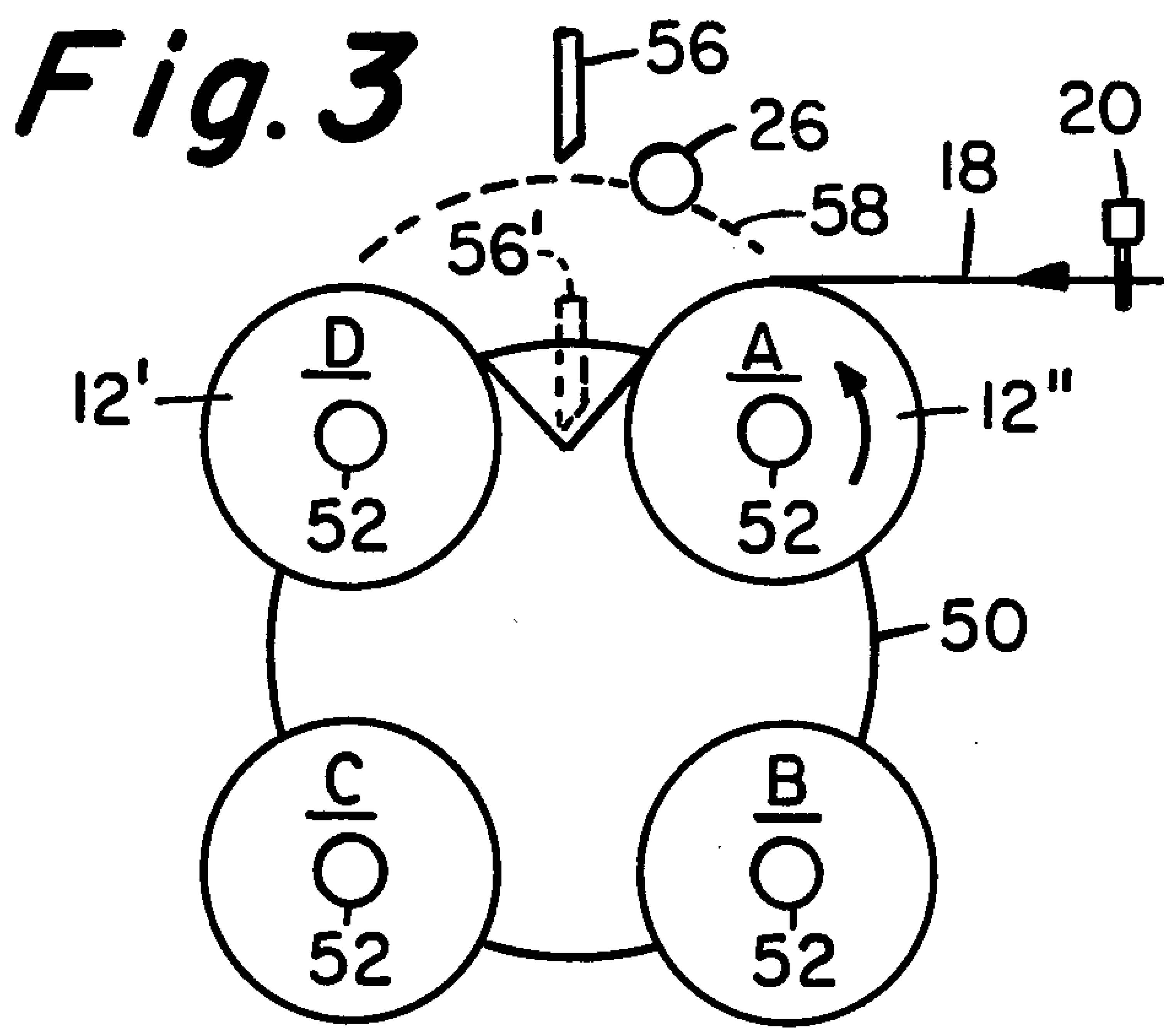


Fig.3

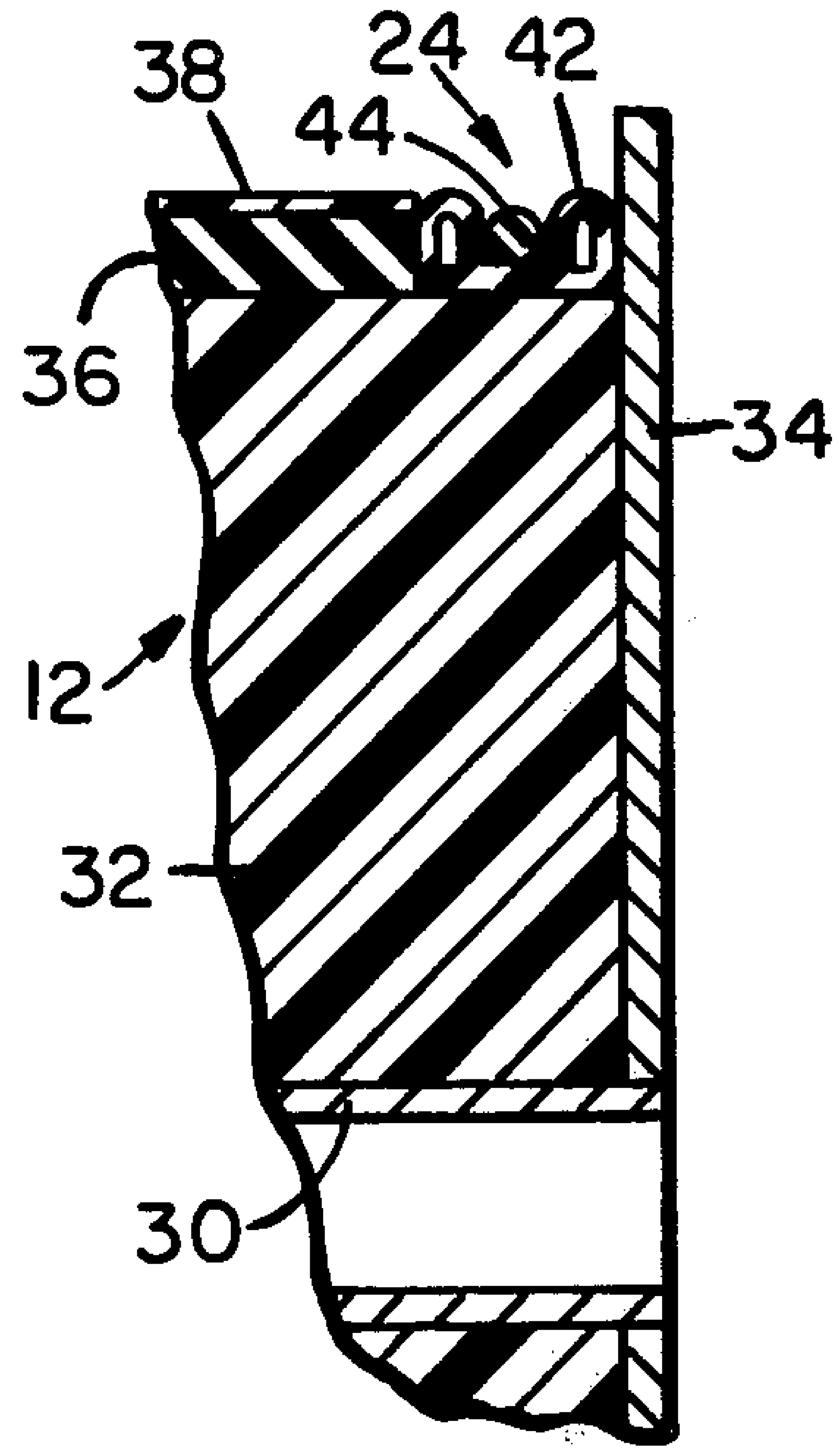


Fig. 2

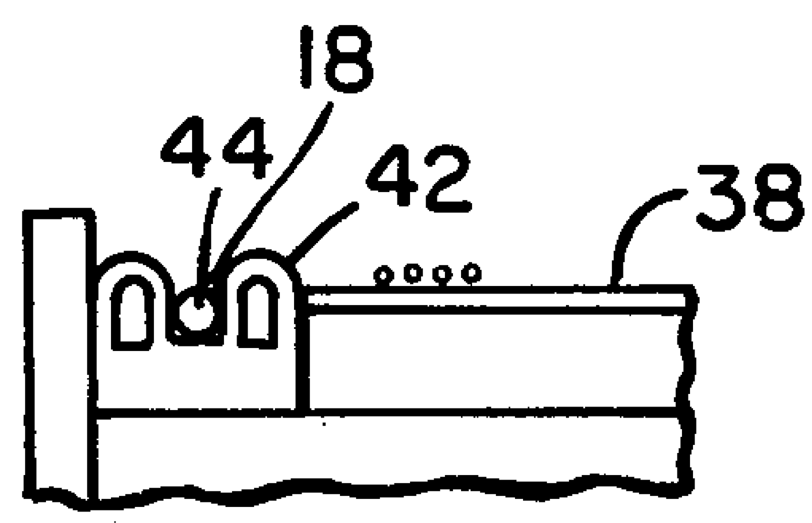


Fig. 4

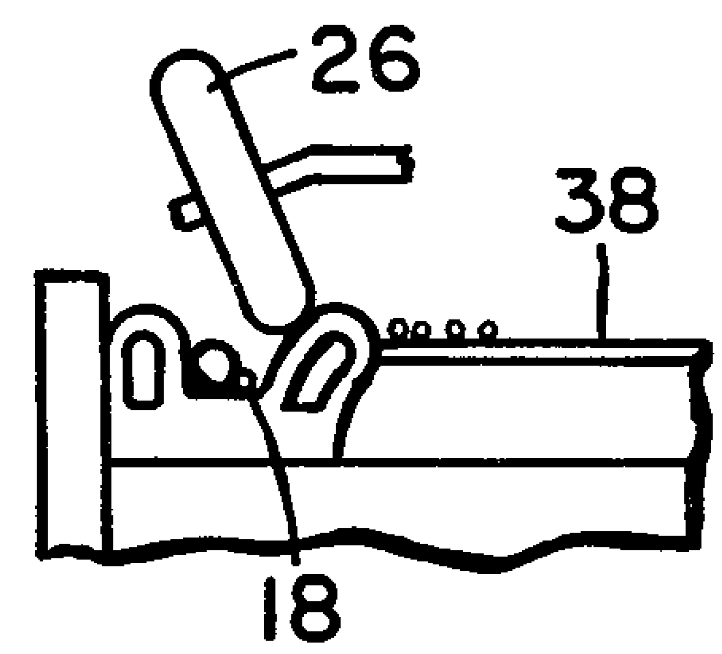


Fig. 5

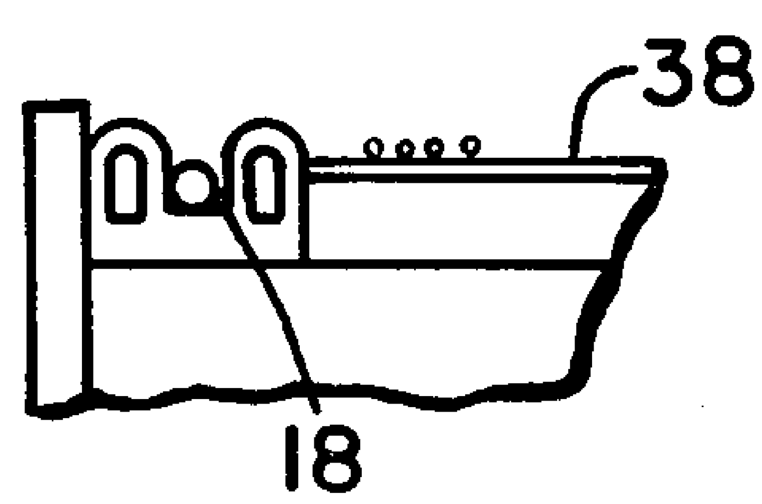


Fig. 6

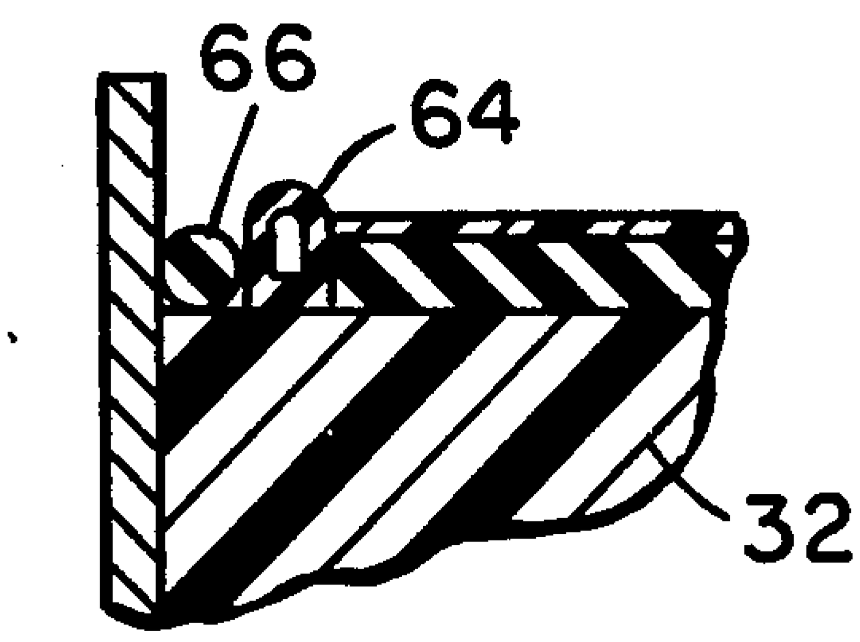


Fig. 7

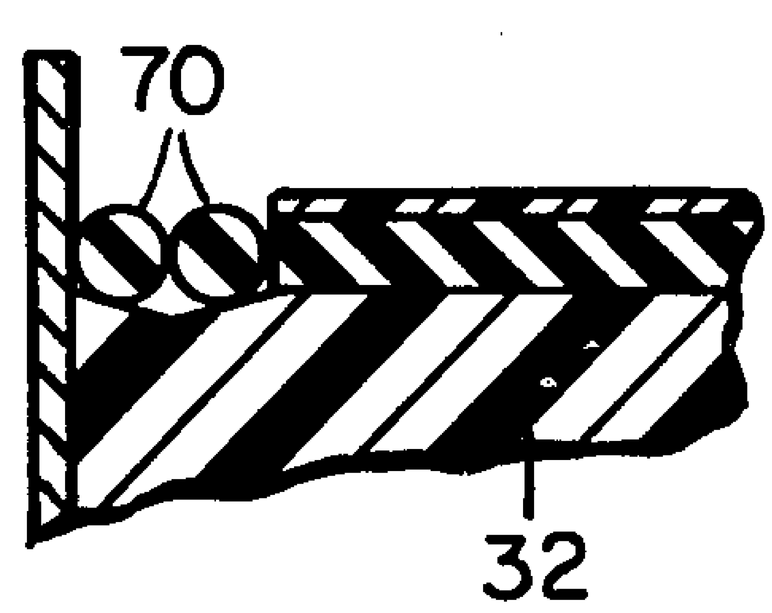


Fig. 8

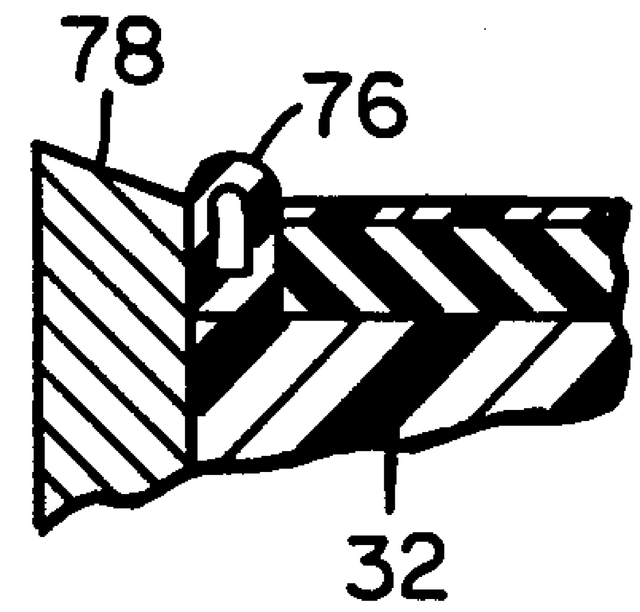


Fig. 9

SPOOL FOR FILAMENT WINDER

BACKGROUND OF THE INVENTION

This invention relates to a spool having means at the ends thereof for automatically gripping a filament to be wound thereon. Such a spool is particularly useful in an apparatus for continuously winding filament, thread or the like on a plurality of spools.

There is presently a need for an apparatus for continuously winding glass optical waveguide filament on a plurality of spools during the drawing thereof. Such apparatus must have means for automatically changing spools, i.e., removing from the winding station a spool that is full, severing the filament from the full spool, and attaching the filament to an empty spool that has been moved into the winding station.

The spool of the present invention is particularly applicable to the winding of relatively fragile filaments such as glass optical waveguides. The characteristics of such optical waveguides and methods of making the same are disclosed in the publication "Doped-Deposited-Silica Fibres For Communications" by R. D. Maurer, Proc. IEE, Vol. 123, No. 6, June, 1976, pp. 581-585. Such fibers are manufactured by initially forming a glass preform from which filaments are drawn. Drawing speeds up to 2 meters per second have been achieved, and speeds up to 5 meters per second are anticipated in the near future. Up to 15 km of filament have been produced from a single glass blank, and the drawn filament is wound on spools containing as little as 25 meters per spool. After the desired length of filament is wound on a spool, it is very difficult if not impossible for an operator to change spools by hand when filament drawing speeds exceed one meter per second. An automatic apparatus for performing this function must be capable of removing a full spool from the winding station, attaching the filament to an empty spool and continuing to wind the filament without breaking it or causing damage thereto, without interrupting the drawing of the filament and without generating an undue amount of waste filament. The filament should not be sharply bent, and the ends thereof should protrude from the spools to facilitate the connection of testing equipment thereto. Presently available spools are incapable of meeting these requirements.

SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide an improved spool for use in an automatic filament system.

Briefly, the spool of the present invention comprises a cylindrically shaped body having a longitudinally disposed bore therethrough. A first annular member is circumferentially disposed around one end of the body, and an annular resilient member is circumferentially disposed around said body adjacent the first member. The space between the first and second members constitute a filament receiving region.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 shows a portion of a filament winding apparatus.

FIG. 2 is a partical cross-sectional view of a spool constructed in accordance with the present invention.

FIG. 3 is a diagram illustrating the operation of a spool changing apparatus.

FIGS. 4, 5 and 6 illustrate the manner in which a filament is retained by the gripping means of the spool of FIG. 2.

FIGS. 7, 8 and 9 are partial cross-sectional views of alternative embodiments.

DESCRIPTION OF THE PREFERRED EMBODIMENT

It is to be noted that the drawings are illustrative and symbolic of the present invention, and there is no intention to indicate the scale or relative proportions of the elements shown therein. The present invention will be described in connection with the winding of optical waveguide filaments although this invention is not intended to be limited thereto.

FIG. 1 shows a portion of a winding apparatus in which the spool of the present invention may be employed. Spool **12** is disposed on a spindle **14** which rotates in the direction of arrow **16**. The position of filament **18** on spool **14** is determined by filament guide **20**. The filament is wound on a central region **22** of the spool and is attached to gripping means **24** located at the ends of the spool. Rollers **26** are brought into contact with gripping means **24** in a manner to be discussed in greater detail below in order to capture and retain the filament. Rollers **26** preferably include a tire of soft material such as rubber so that they do not abrade the filament.

A preferred embodiment of spool **12** is shown in FIG. 2. Plastic tube **30** is disposed in an aperture extending through cylindrical styrofoam body **32**, the ends of which are provided with plastic flanges **34**. A foam rubber layer **36** is disposed around body **32** to cushion the filament. Layer **36** may be covered by a thin plastic layer **38**. Gripping means **24**, which is disposed at each end of body **32** between flange **34** and layer **36**, comprises a hump rubber extrusion **42** having a rubber O-ring **44** disposed between the two humps thereof. The region between one of the humps **42** and O-ring **44** is referred to herein as the pinch line.

The winding spool of the present invention is advantageously employed in a system for winding glass optical waveguide filaments. It is desirable to test such filaments on the spool immediately after they are drawn. Foam rubber layer **36** helps to relieve stresses in the wound filament that could cause the testing apparatus to record loss which could be induced by such stress. Moreover, filament gripping means **24** facilitates the attachment of the filament to the spool in such a manner that the ends thereof protrude from the spool for attachment to the testing apparatus.

Referring to FIG. 3 there is shown a vertical indexing turret winder having four stations: wind station A, wait station B, load station C and unload station D. The winder comprises turret plate **50**, around the circumference of which are disposed equally spaced spindles **52**. Empty spools are loaded in station C and full spools are removed in station D. A detailed description of this winding system is set forth in commonly assigned U.S. patent application Ser. No. 902,977 entitled "Winding Apparatus for Glass Optical Filaments" filed on even date herewith, now U.S. Pat. No. 4,138,069, said application being incorporated herein by reference.

Turret plate **50** is indexed 90° during each cycle. The spindles in stations A and B rotate at the winding speed, and that at station D rotates at the winding speed until the filament extending between spools at stations A and D has been severed. A cut knife **56** includes a blade having V-grooves which are located in the planes extending through the pinch lines of the spools of stations A and D. Thus, when a filament extends between one of the pinch lines of the spool of station A and the corresponding pinch line of the spool of station D, the filament extends directly beneath a corresponding V-groove of knife **56**. The knife is so designed that it does not cut the filament on contact but can depress the filament as shown in FIG. **3** wherein the knife is schematically repesented. When the knife reaches the position illustrated by dashed lines **56'**, the knife blades are caused to move horizontally and cut the filament which is then located at the bottom of the V-groove. About one second after the filament extending between the spools of stations A and D has been severed, the full spool in station D stops rotating. Thereafter, means is actuated to remove the spool from station D.

The manner in which a filament is caused to be gripped by means **24** is illustrated in FIGS. **4–6**. As shown in FIG. **4** filament **18** is guided from plastic layer **38** to the pinch line between a section of the hump rubber extrusion **42** and O-ring **44**. The winding tension is insufficient to cause the filament to pass through the pinch line at the point of contact between numbers **42** and **44**. While the spool is turning, roller **26** moves to the position shown in FIG. **5** and depresses the hump rubber away from the O-ring, thereby creating a gap through which the filament falls. Since the spool is turning, the gap is always forming and closing as the rubber hump passes under the roller. After the roller retracts the gap remains closed.

The operation of the disclosed winding apparatus is as follows. With filament guide **20** in line with one of the end sections of the spool in station A, filament **18** is threaded through the filament guide and over the respective pinch line of the spool. The pinch line rollers are actuated so that a gap between members **42** and **44** is opened and the filament falls therethrough as illustrated in FIG. **5**. As the roller passes, the gap closes, thereby causing the filament to be captured by such gripping means. Guide **20** then guides the filament to the winding section **22** of the spool, and filament **18** is wound across plastic layer **38**. When the spool is full, guide **20** positions the filament in the pinch line at the opposite end of the spool. Turret plate **50** then indexes 90° causing the full spool from station A to be positioned at station D. As the full spool is being indexed to station D, it contacts rollers **26** as illustrated by dashed line **58** in FIG. **3**. This momentarily opens the gap between members **42** and **44** causing the filament to be captured thereby. As an alternative method of operation, rollers **26** can be positioned above the path of rotation of the full spool and can be lowered into contact with the full spool while it is still in station A.

As a full spool indexes out of the winding station, an empty spool indexes in, the filament being automatically positioned in the pinch line of the empty spool but traveling over it until the rollers open the gap. In FIG. **3** the full and empty spools are represented by numerals **12'** and **12''**, respectively. With the index complete, rollers **26** descend and open the pinch line gap at the edge of the spool in station A to permit the filament to fall therein. Until the filament extending between spools **12'** and **12''** is cut, it is continuously pulled out of the gripping means of spool **12''** and is wound around the gripping means of spool **12'**. The cut knife then deflects downwardly the filament extending between spools **12'** and **12''**. This deflection of the filament increases the length of filament which is in the pinch line gap of spool **12''** prior to cutting and makes the transfer of filament to spool **12''** more reliable. As soon as the filament is cut, it remains in the gripping means of spool **12''**. The rollers can be retracted simultaneously with the cutting of the filament or just thereafter. Spool **12'** stops rotating about one second after the filament is cut, and the full spool is now free to be unloaded. Knife **56** then retracts. Guide **20** then moves the filament back onto region **22** of the newly started spool which begins to wind filament.

Other types of filament gripping means are illustrated in FIGS. **7–9**. In FIG. **7** a single hump hollow rubber extrusion **64** is disposed adjacent O-ring **66**, the pinch line existing therebetween. An advantage of employing a hollow member such as extrusion **64** lies in its ability to be easily deflected a sufficient distance to permit the passage of a filament between it and the adjacent member.

In FIG. **8** the pinch line is disposed between two O-rings **70**. In this embodiment the surface of body **32** under O-rings **70** contains a shallow V-shaped groove which causes the O-rings to bear against one another to maintain a closed pinch line except when roller **26** creates a gap.

From the above-described embodiments it can be seen that the basic requirement of the gripping means is an annular, resilient member that is normally disposed against the adjacent surface of another annular member. This is illustrated in FIG. **9** wherein annular, resilient member **76** is disposed around one end of cylindrical body **32**. The adjacent annular member **78** has a surface which is in contact with member **76** and forms a pinch line therewith. Member **78** can consist of resilient or rigid material and could be the end flange of the spool. The outer circumferential surface of member **78** is preferably tapered toward member **76** to cause a filament that is positioned thereon to slide into abutment with member **76**. Any surface over which the filament passes, such as the surface of member **76** and that of the winding region of the spool, should consist of a soft material such as plastic or rubber to avoid abrading the surface of a glass filament.

I claim:

1. A spool adapted for use in the winding of filament, said spool comprising

- a cylindrically shaped body having a longitudinally disposed bore therethrough,
- a first annular member circumferentially disposed around one end of said body, and
- an annular resilient member circumferentially disposed around said one end of said body adjacent said first member, the space between said first member and said resilient member constituting a filament receiving region, said resilient member being flat on the side thereof which contacts said body, the opposite side of said resilient member having two spaced hollow rounded portions, said first member comprising an O-ring disposed between said spaced rounded portions.

2. A spool adapted for use in the winding of filament, said spool comprising

- a cylindrically shaped body having a longitudinally disposed bore therethrough,
- a first O-ring circumferentially disposed around one end of said body, and
- a second resilient O-ring circumferentially disposed around said one end of said body adjacent said first

O-ring, the space between said first and second O-rings constituting a filament receiving region, that portion of said body adjacent to said first and second O-rings having a shallow, V-shaped groove.

3. A spool adapted for use in the winding of filament, said spool comprising

a cylindrically shaped body having a longitudinally disposed bore therethrough,

a first annular member circumferentially disposed around one end of said body, and

a hollow, annular member of resilient material circumferentially disposed around said one end of said body adjacent said first member, the space between said first member and said resilient member constituting a filament receiving region, said resilient member being flat on the side thereof which contacts said body, said resilient member having two hollow spaced, rounded portions on the side thereof opposite said flat side, said first annular member being disposed between said two rounded portions.

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